A YEAR ON A TIGRIS ISLAND

BY

E. P. WILTSHIRE, F.R.E.S.

(*With a map, 3 plates, one text figure and a graph*)

SYNOPSIS

This paper describes the vegetation and associated animals of a small island on the River Tigris, Iraq, as affected by the progress of the season and the action of the waters throughout one year. Particular attention is paid to the Lepidoptera, which are grouped into three classes: (1) those resident on the island, (2) the temporary colonists, (3) the casual visitors. Different vegetational zones at different heights, due to the period of submergence, were observed, and the possibility of insects inhabiting each was studied. A striking feature was the coincidence of the season of maximum insect activity with the annual high floods covering all the ground but not the tree-tops; another, was the impermanence of the habitat, due to the violent erosion. Despite this, the habitat was of great natural interest, approximating more closely than the flora and fauna of the neighbouring banks to the virgin or primary river-biocoenosis of Mesopotamia. For, although certain species of plant and insect are exterminated on such islands by the annual submergence, the flora and fauna of the banks, protected by high bunds from flooding, are now subject to very great human interference. Photos illustrate the floods, and a map and a graph show the variation of temperature, humidity, water level, and insect activity on the island throughout the year and also the rate of the silting up of the smaller channel on one side of it. The river-flora and fauna of the Nile and the Jordan are compared with those of the Euphrates and Tigris, and the difference explained in geographical and historical terms. A new species of Lepidoptera, *Celama harouni*. Wilts. (Artiidae, Nolinae) is described and its characters illustrated.

NARRATIVE

Residing in Baghdad continuously from October 1936 to November 1937 and having at my disposal a folding-canoe, I was able to visit Karradah Island at regular intervals throughout that period, and keep a diary of my natural history observations. Not only the insects collected and the animals observed were noted down, but a descriptive narrative of each visit was made, together with a note of the water-level, maximum and minimum temperature (as published in the 'Bagdad Times') and other climatic conditions of the day of the visit. Naturally the completed diary contained many tentative remarks and redundancies which a publication should omit. The diary is therefore here condensed into a graph and a month-by-month description of the reactions of insect and plant life on the island to the caprices of the river Tigris and the Iraqian climate. This part, however, is preceded by an

introduction and general discussion; it is followed by a list of the lepidoptera.

Introduction

The Tigris at Baghdad is confined within high bunds or levees, but only fills up the intervening space when in spate. Inside these banks high water is twenty-two feet above low water. Islands inside the bund are subject to one or more submersions every year, when the floods come. Despite this, many islands are rich in insect life, as the following notes show.

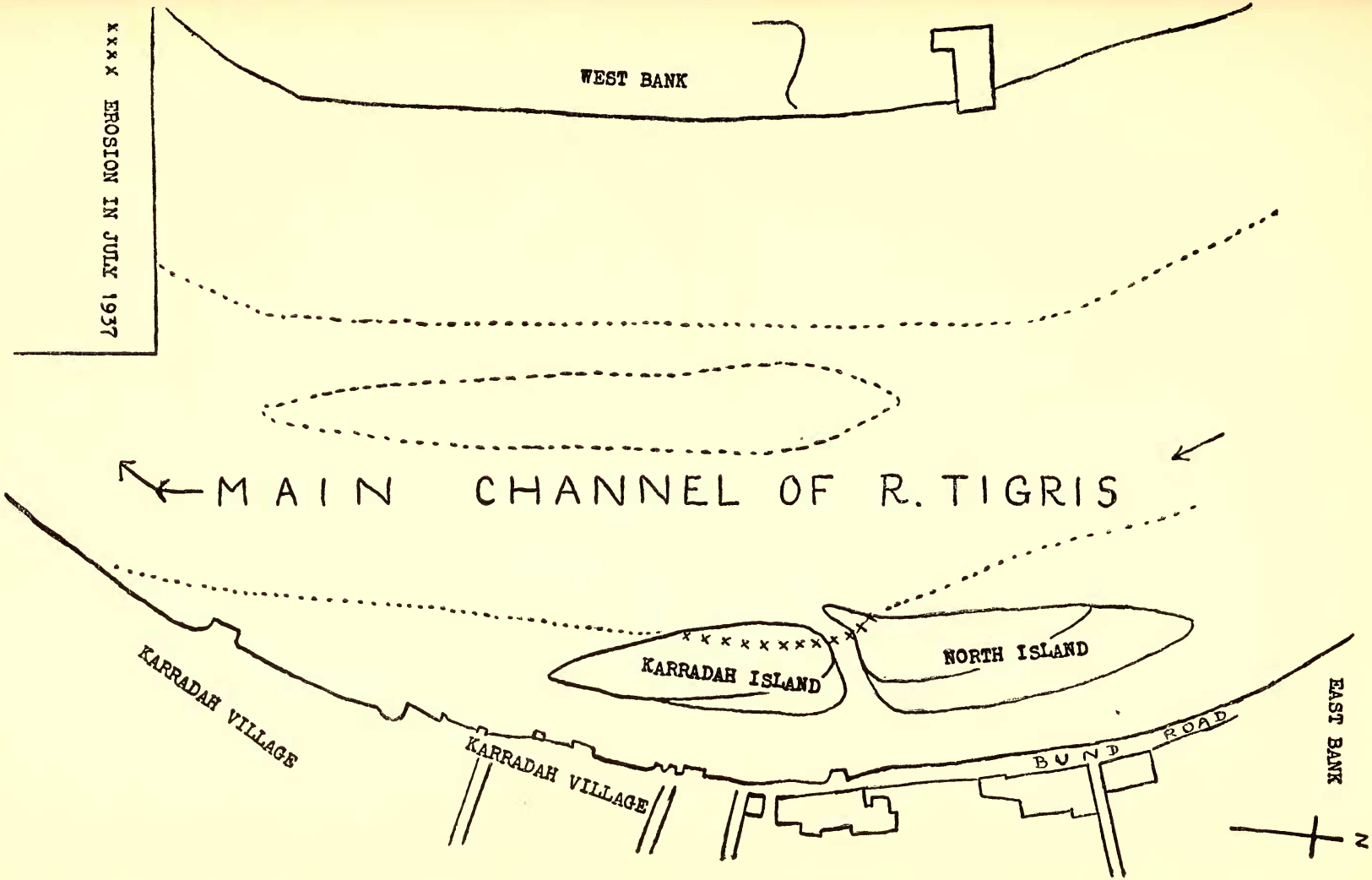
Karradah island proper was * in 1936-37 about half a mile long and some two hundred yards across its widest point. It was closer to the eastern bund of the Tigris, being separated from the western bank by the main stream. Opposite the island on the western bank were gardens which provided a very favourable ground for insects; but the eastern bank was built over. The island was overgrown, along its whole length, with Euphrates poplar and tamarisk. The best growth of poplar (i.e. the biggest trees) was along the western side of the island, which here fell steeply into the main channel; but towards the southern end of the island the wood of big trees was some twenty or thirty yards across. The highest growth of tamarisk was to be found eastward of the highest growth of poplar. The eastern side of the island sloped gradually down to the minor channel, and on this slope the two trees were represented by scrub and shoots, those at the lowest level of all forming a green belt less than a foot high. Other trees did not occur on the island; willows in the Baghdad district were only found along irrigation-ditches and presumably required planting; and other Baghdad trees, found only on the mainland, included date-palm (*Phoenix*), nebek (*Zizyphus spina-christi*) mulberry, fig, orange, apricot and apple.

As for low plants and bushes, whereas the bunds were overgrown above a certain height with *Alhagi*, *Prosopis stephaniana*, and caper, none of these three occurred on Karradah island, whose vegetation, other than trees, consisted of various grasses, dock, burr (*Xanthium strumarium* L.) *Polygonum*, *Phragmites*, and *Glinus lotoides* L.; the *Phragmites* were however too few and impermanent to produce typical reed insects. Pig island, a much larger island a mile further downstream, escaped regular inundation, I believe, at that time; it had fewer trees and was thickly overgrown with *Lycium*, which was absent from Karrradah Island. The low plants of Karradah Island were buried annually by a thick mud deposit; the soil of the island was all alluvial, containing no single stone.

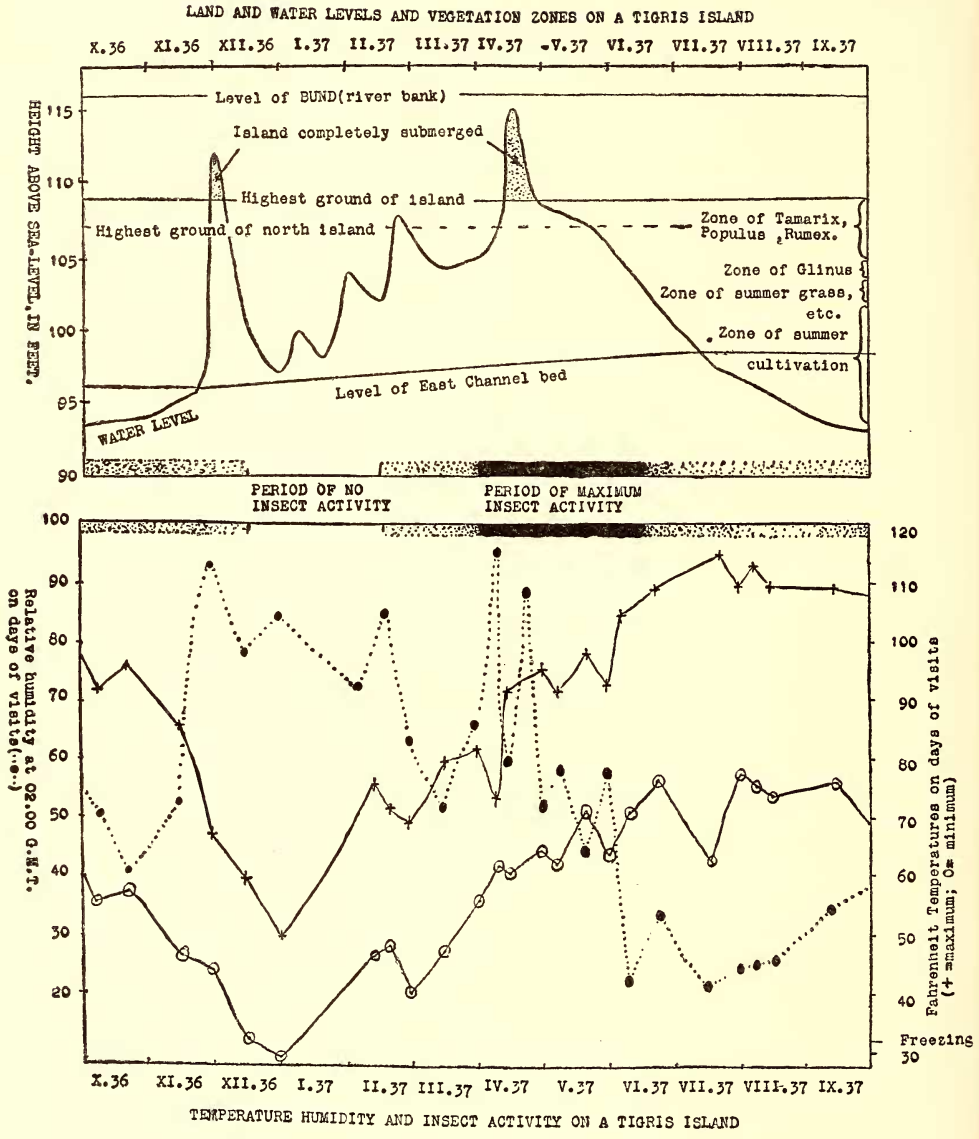
Thus, except for those species of plant or tree and animal which are apparently exterminated by inundation (one presumes the floods account for the absence from the island of such plants or trees as *Alhagi*, *Prosopis*, *Zizyphus* and *Lycium*) the island presented the wild riverain oasis flora and fauna of Mesopotamia, unimpoverished by human interference. The mainland, on the other hand, though possessing those missing species, was spoilt, from a naturalist's point of view, by cultivation.

---

* On revisiting Baghdad in 1943 I found that the entire island with all its trees had disappeared.



MAP OF THE TIGRIS NEAR BAGHDAD



TEMPERATURE HUMIDITY AND INSECT ACTIVITY ON A TIGRIS ISLAND

To the north of Karradah Island, a lower island stretched upstream; its highest parts were overgrown with poplar and tamarisk scrub, not high enough in 1937 to protrude from the water at its highest level; at normal levels, however, a stretch of perhaps a third of a mile broke the surface, and at low water it was united with the bank and partly cultivated. This island is referred to hereinunder as North Island.

During the year for which the island was visited and observed (October 1936—October 1937), two floods occurred high enough to cover the highest ground of Karradah Island, though not, of course, its big trees: a small sudden flood on November 30th, which lasted two or three days, and a higher flood, lasting for at least ten days, in April. The former was exceptionally early, and was due to cloudbursts in the plains and foothills of Northern Iraq; it was indeed so unexpected that irrigation constructional enterprises on the Tigris suffered heavy losses in equipment; but though unusual, this occurrence in no way detracts from the value of a study of this particular year, for the Tigris is notoriously capricious, and unusual behaviour is almost normal. The second flood, of course, was derived chiefly from the melting snows of Armenia, Kurdistan, and Persia. It might be mentioned that during the previous year, Karradah Island was submerged in April and again in May (1936). No matter when this spring flood actually comes, the island's soil is always very damp from March till June, for the melting snows and spring rains maintain the river at a high level for several months; in late summer, when the main stream flows under twelve-foot cliffs and the lesser channel is dry, the island's sub-soil water-level is considerably lower.

From about mid-December to mid-February the cold suppressed all insect life; the period of maximum activity lasted from the beginning of April to the middle of June; a period of renewed but lesser activity occurred in September and October, characterised by the frequency of other species than those most prevalent in the first period.

Special attention was paid to lepidoptera; notes were made about other orders (and, indeed, of bird and plant life too) but only a few specimens of these were collected and authoritatively named. Only the lepidoptera were collected and studied in sufficient detail to enable the drawing up of a full list, showing their status on the island. The identification of the more difficult species has taken more than ten years!

First the exact meaning of certain words used hereinunder should be explained. By the 'outer' edge or side, is meant that side of the island furthest from the main stream, the side washed by the lesser branch, i.e., in Karradah Island, the eastern side; for Karradah Island is on the left side of a river flowing southwards. The 'lower' end is therefore the southern end; the 'inner' side, is that washed by the main stream, i.e. the western; and the 'upper' end, the northern.

Every time the river covered the island, a thick deposit of silt was laid down; every year, therefore, the island grew higher. But the minor channel, on the outer side of the island, grew shallower even more quickly, since it was under silt-laden water for a longer period. The slower the stream, the more silt was dropped; in certain conditions sand was deposited: and the stream always flowed more swiftly rising than falling. During the few days for which the island was submerged, the stream was usually very rapid, and very full of silt; in

places, the lack of undergrowth and wide spaces between the trunks of the big poplars, allowed the water to pass across the island very fast, while in other places the young scrub checked the flow. In either event, of course, the fastest water was in the main channel, and consequently the water crossed the island from east to west. The stream was more gentle during the long period for which it filled the eastern channel without covering the island; in late summer and autumn, the only season when the water was really pure, the eastern channel was dry. The natural tendency of the island and its vegetation, therefore was to extend in breadth outwards, invading the bed of the lesser channel which became, each year, higher and drier. In compensation, the main channel eroded the cliff-like inner edge of the island, destroying its highest part where its flora and fauna had been longest established. A Tigris island, therefore, is a fluid thing, and I doubt if many islands can be older than a century. As the course of the main channel shifts inside the wide limits of its two bunds, new banks appear, are peopled with plants and insects, and are wiped out again. But the life survives.

The general climate of Baghdad, situated in the middle of the Great Palaearctic Desert, is marked by extremes of temperature, a certain amount of rain in winter, great dryness and heat in summer and violent winds. On Karradah Island some of these were mitigated by the prolonged moisture of the soil and the consequent density of vegetation that reduced the high evaporation typical of the true desert. The island, indeed, was used as a summer-evening resort by the inhabitants of Baghdad, on account of the coolness and freshness of its air. The annual submersion and silting-over of its whole surface, however, had so far deterred ambitious mayors from trying to urbanise it with flowerbeds, paved walks, or swimming pools, and it remained wild and sylvan in 1937. A municipal keeper visited it daily, to see that its extensive timber was not plundered; but a certain amount of lopping (chiefly of tamarisk) was even then permitted.

Similar conditions prevail on the alluvial reaches of the Euphrates and the Karun, except in three particulars: the Euphrates is more regular than the Tigris in its movements, and carries less suspended matter; the Karun is even more irregular and silt-burdened than the Tigris, being shorter; and in the immediate neighbourhood of Basra and the Shatt-el-Arab, the river is tidal and the marshes and sea render the air more humid that in summer in Baghdad; Baghdad is a city in a desert.

My visits and observations at once suggested the problem of whether a species of insect survived submersion, or was killed by it and recolonised the island later. I am convinced, from what I saw, that those insect species biologically dependent on the poplar and tamarisk survive the floods, which must, however, destroy many individuals; I am equally convinced that other insects, dependent on low herbage, (e.g. *Laphygma extgua*, *Loxostege nudalis*, *Hymenia fascialis-recurvalis*, etc.) are only late summer and autumn colonists from the mainland and are exterminated annually by inundation. There are however other insects, also biologically dependent on low herbage, which appeared so promptly after the subsidence of the flood-waters that I feel it very probable that they survive submersion. Among these may be mentioned *Rhodometra sacraria*, *Rivula sericealis* and *Nomophila noctuella*. Altogether, of the

COMPARATIVE VIEWS OF KARRADAH ISLAND
TO ILLUSTRATE FLOODS

Fig. 1. The main drive, with the wood of full-grown poplars in the background, and the Tigris mainstream behind them ; looking west ; 1. xi. 1936.

Fig. 2. Exactly the same view (except that camera was higher) ; 17. iv. 1937.

COMPARATIVE VIEWS OF KARRADAH ISLAND
TO ILLUSTRATE FLOODS

Fig. 3. North Isl
viewed from the en
Karradah Island, she in
the autumn cultivaon
1. xi. 1936.

Fig. 4. Exactly the same view,
one month later ; 1. xii. 1936.

Fig. 5. The same view, 6. ii. 1937 shewing
channel between North I. and Karradah I.

so-called 'Macro-lepidoptera' I think that 22 species can be regarded as permanent residents of this or similar Tigris islands, i.e. wooded islands liable to flooding. Four of these however I did not actually take on this particular island: it is from later observations elsewhere in Iraq and Persia that it has become clear that these four also belong to this ecofauna; they are listed in brackets.

As regards islands not liable to flooding annually, their flora and fauna is not distinguishable from that of the irrigated Mesopotamian plain, to which I have devoted two 'habitat articles', e.g. The Lepidoptera of a Baghdad Orchard, (*Ent. Rec.* **51**, 1939,) and Some notes on the Insects of the Shatt el Arab Oasis, (*ibid.*, **62**, 1950.)

In listing the lepidoptera at the end of this article I have grouped the above twenty-two residents separately from those which, though taken on the island, are annually exterminated by the floods, or do not even attempt to breed there. In other orders, the cockchafer (sp. ?), the cicada *Cicadatra glycyrrhizae* Klti. and perhaps the bug *Apodiphus amygdali* Germ., are also permanent residents, though in both the latter cases they would appear to be somewhat unsuitably named, for neither liquorice nor almond grows on Karradah Island.

Visitors of passage constitute a third class, of less scientific interest than either the permanent residents or the temporary colonists, but in some cases it was hard to say whether a species belonged to the second or the third, i.e., was a temporary colonist or a casual visitor. Many more of the latter would certainly have been taken on the island, especially in the late summer and autumn, if visits had been more frequent and collecting intenser. The occurrence on the island of this class, consisting of the ordinary population of the oasis of Baghdad, has no significance. In fact I took about twice as many species on the adjacent mainland as I did on the island altogether.

Origins of this Ecofauna

The temperate or Palaearctic species predominate in this river island ecofauna; the Eremic species are fairly well represented and are Palaearctic-Eremic rather than Tropical-Eremic. The Tropical category is fairly well represented, but in a distinct minority; it is better represented in the more migratory classes than in this resident class. The geographical spectrum is as follows, and the terms are explained in the footnote * :—

Palaearctic

Euro-Siberian 2, Euroriental 3, Anatolian-Iranian 7, Pan-Eremic 3, Eastern-Eremic 2, Endemic-Eremic 1 species.

---

* Euro-Siberian are Cool-temperate species ranging from the Atlantic across Siberia to the Pacific.

Euroriental are Temperate species ranging from S. Europe to S-W. Asia, some from Britain to W. China. Anatolian-Iranian are Warm-temperate species with headquarters in the plateaux of Anatolia and Iran, and in some cases reaching the Balkans, and Afghanistan.

Eremic species are those with headquarters in the deserts and steppes north of the Equator in the Old World.

Pan-Eremic are those Eremic species distributed from West Africa to Central Asia; Eastern Eremic are those Eremic species not found west of the Nile; Endemic Eremic are those only known from Iraq at present.

Tropical

Palaeo-Tropical 2, Indo-Malayan 1, Ethiopian 0 species.

Doubtful

1 species, which will probably prove to be Anatolian-Iranian or Eremic.

The actual attribution of each of the twenty-two species to these categories is given in the list below.

The Euphrates poplar tree characterises the biotope which this article studies, and the well-known fact of its occurrence and indeed dominance along the banks of the Jordan, as well as in the Euphrates-Tigris basin, has already suggested to writers the common origin of the flora and fauna of these two river-valleys now separated by the wide and waterless expanse of the Syrian desert. The tree's world-range must also be considered; its western limit is apparently at Siwa Oasis in North-Western Egypt; its next nearest stands are five hundred miles distant, viz., in Arabia Petraea and Palestine. To the north it reaches South-East Turkey, and to the east of the Tigris it occurs quite commonly in various Persian rivers, even at 5,000–6 000 feet heights, e.g., the Zaindeh Rud at Isfahan, and the Kur at Bandamir (Fars). It is also dominant in the Tarim river-basin in the Sinkiang desert, and may even extend further eastwards in the deserts of Asia. Unfortunately information is lacking about the insect fauna of this tree at the two extremities of its range. If any species were found to attend the tree throughout its entire range that species might be fairly deduced to be of extreme antiquity and to date from the evidently geologically remote age when the tree's range was less broken up than now. The lepidoptera of Palestine however are quite well-known, and it is remarkable that of the twelve poplar-feeding species found in Baghdad, only five are definitely known from Palestine, e.g. *Catocala elocata, puerpera* and *lesbia*, *Acronycta aceris* and *Pandesma anysa*. The tamarisk-feeders on the other hand are the same in both countries. The probable cause of the poorer representation of the poplar-fauna in Palestine is the absence in Syria and Palestine of any river flowing from the Anatolian plateau southwards the whole length of those countries, in the way that the Euphrates and Tigris flow right through Iraq. The poplar-insects are evidently derived from the poplar-feeding fauna of Anatolia and Iran, and the relations of this fauna to the poplar-feeding fauna of Central Asia must for the present remain uncertain.

This fauna becomes progressively weaker as the rivers issuing from the Turkish and Persian mountains reach lower, drier, hotter and more southerly tracts; at Baghdad the fauna is still comparatively rich, though the absence of *Saturnia pyri* (feeding on *Populus euphratica* at Shapur in Fars !) may be noted; while at Basra and Ahwaz it is very poor.

The tamarisk-feeding fauna, which is discussed in Part II of my ' The Lepidoptera of the Kingdom of Egypt ' (*Bull. Soc. Fouad I. d'Ent.* 33. (1949), is Eremic, some members being Pan-Eremic. The direction, therefore, from which such species as *Macaria aestimaria* reached our Tigris island is anybody's guess, and we can hardly venture further than to say that here they are more or less at their centre of distribution.

The different origin of the Tropical elements of the Jordan valley, on the one hand, and the Euphrates-Tigris basin on the other, is very marked and contrasts strongly with the common origin of the Temperate and Eremic species of these two basins. The Tropical components of the Jordan fauna link that river with the Nile rather than with Asia. Of course, it is true that India and Africa share many species of their Tropical fauna, and the Ethiopian and Indo-Malay categories can be to some extent grouped into a single Palaeo-Tropical fauna, of which the Ethiopian and Indian components are fairly closely related. Some of the species common to both inhabit the Tigris, Jordan and Nile valleys alike (e.g. *Pandesma anysa*, *Danais chrysippus*, *Lampides baeticus*) and shed little light on the origins. These three, it may be noted, are all migrants. But *N. siva* (not a migrant) is one of several Tropical Indian species inhabiting the Tigris valley (also South Persia); it reaches no further westwards. The tropical species of the Jordan valley on the other hand reached that depression from Africa via the rift valley at Akaba and some reach their easternmost limit there.

Owing to Iraq's more northerly situation and to the absence of rivers flowing northwards, like the Nile, out of the Tropics, there is no *Acacia* in the Tigris valley. The nearest natural stand of this tree known to me is at Bushire (S.-W. Persia). The absence of this genus of trees has deprived the river fauna of many Sudanian-Deccanian species found in the Jordan valley and Dead Sea vicinity; while the converse is the case in Egypt, which lacks an indigenous poplar-or willow-feeding fauna. Thus the Nile's fauna at Cairo is predominantly Tropical and Eremic, while the fauna of the Tigris at Baghdad is predominantly Temperate and Eremic. (Parodoxically, summer at Baghdad is hotter than at Cairo!) The direction of the flow of the principal river is decisive in determining the flora and fauna of its banks and islands, in Egypt and Iraq.

In comparing origins, we must also remind ourselves of the recent emergence from the sea of the plain of Southern Iraq. Baghdad and the island of our study were all under the salt waters of the Persian Gulf during much of the Pleistocene, and perhaps as recently as the last glaciation.

Chronological Notes

January:

The water was low most of the month (98 feet), but rose at the end to 104 feet, a level which I consider normal because it leaves exposed the tree-, or scrub-grown high ground of both islands, but covers their sandier lower parts, which are submerged too long for tamarisk and poplar to grow there and which are cultivated during the summer.

The weather was too cold for insect activity; humidity was high.

February:

At the beginning of the month, the water rose to 106 feet after some rain in Northern Iraq; then dropped again to 104; and on the 21st, rose abruptly to 108. At this level, North Island was covered, but the higher parts of Karradah Island were still exposed. A height of 109 feet is necessary to cover the ground of the latter completely.

On the upper end of North Island (a gradually shelving mud spit) sea-gulls, hoody crows, and some smaller birds constantly collected, attracted by the city's refuse, washed up there. Kites (*Milvus migrans*)

were also seen on N. Island, and hoody crows (*Corvus cornix capellanus*) were common in the big trees of K. Island.

A carpet of dead leaves still covered November's silt deposit on K. Island, fresh mud was deposited early in the month on the 'glinus-shelf' at the island's upper, inner corner (this shelf is described under November and December, below), so that all except the glinus plants at the very top of the slope were buried; the mud's surface was pierced only by a few tamarisk stems, an occasional live dock, and one or two large dead burr stems. Rain fell during the month and humidity was high. At the end of the month, as the temperature rose, the poplar-buds burst and young leaves and catkins appeared.

A visit by canoe on the last day of the month revealed young leaves on tamarisk also, and, in the open spaces and clearings of K. Island, fresh grass, dock, and polygonum, and a rough-leaved, pink-flowered crucifera, whose leaves were being mauled by a coleopterous larva. *Pieris rapae* visited these flowers, large dragon-flies were on the wing, and crickets; grasshoppers and ground-spiders were seen in numbers in the clearings; in the wood of big poplars there is no undergrowth at any time of the year, but here many of the same large, quick-running spiders were seen. Small spiders were noted on the poplar trees, and three species of ant:

No. 1 was very small, quick-moving, and shelter-loving. Certain trees seemed to have been killed by it, their bark being quite dead loose from the trunk and burnt-looking. They seemed to prefer the inner surface of thin, smooth bark, but were noted on old more rugged trunks. A pupa of *Plutella maculipennis* was found among a swarm of this ant, under some loose bark; they were not molesting it, and it produced the imago on 21.iii.37.

No. 2 was rather larger, and lived deeper in the wood, often however coming to the surface through holes or cracks in the bark.

No. 3 larger and solitary; a slow mover, often surrounded by swarms of No. 1.

I also noted a *Cerura turbida clarior* Wilts. cocoon, with a slight hole at one end. On opening the cocoon it was found to contain a swarm of ant No. 1, which could only have entered through this hole, presumably made by the emerging imago some time previously. The pupa case was also full of ants, but since there was no sign of juice or fat, I assumed it had been empty when the ants arrived; what they were doing there, I failed to understand.

A small beetle was also noted, common on poplar bark.

About the same time *Celama* hibernating larvae, found the previous autumn on tamarisk, resumed feeding.

March:

The water remained at 104 or 105 ft. all the month.

Hot sunny weather, tempered by heavy dews and a fall of 33 degrees fahrenheit at night. Vegetation in the clearing grew rank.

The insects mentioned for the end of February remained very much in evidence; the shrill chirping of grasshoppers on the island could be heard clearly on the east bank at the end of the month. Pale grey weevils appeared in profusion, on low plants and tamarisk bushes.

Larvae of *P. anysa* fed up rapidly on poplar, some being mature at the end of the month; imagines of *Dicranura intermedia* and *Cerura*

COMPARATIVE VIEWS OF KARRADAH ISLAND
TO ILLUSTRATE FLOODS

Fig. 6. Tamarisk jungle, viewed from the main drive, looking north-east from the same spot as the photo below ; 1. xi. 1937.

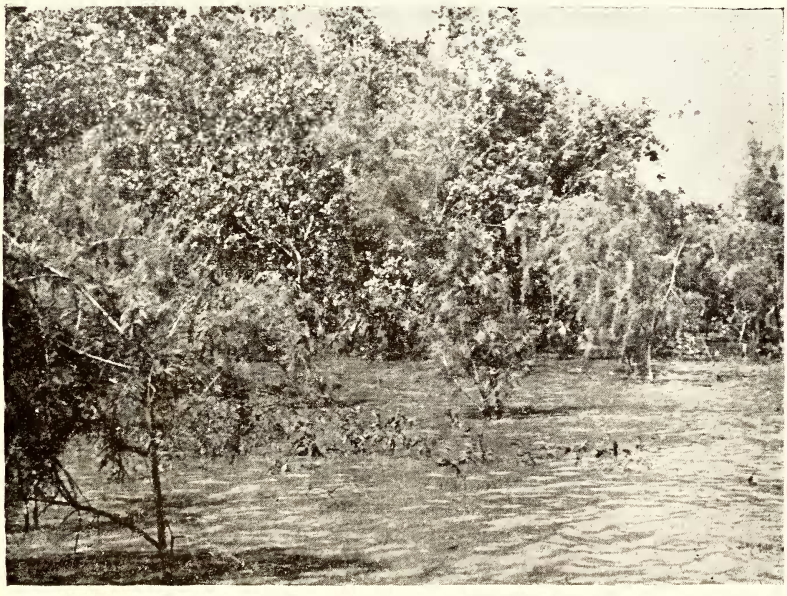


Fig. 7. A view from the same spot, looking northwards, shewing poplar wood on left, tamarisks on right and in foreground ; 17. iv. 1937.

turbida clarior were on the wing, and *Eusphecia pimplaeformis* pupated. Pupae of *Acronycta aceris johanna* and *Nadiasa siva* were found in cocoons on poplar trunks, and produced imagines in mid-April and 26th March respectively.

April :

About the 10th, the river began rapidly to rise, because of a combination of the melting snows in Kurdistan and heavy rains in N. Iraq. On the 16th, having stood at 115 feet for three days, the Tigris broke its banks north of Baghdad and flooded a wide stretch of desert east of the city.

The weather in Baghdad was on the whole fine, though some rain fell after the peak of the flood had passed. The heat was tempered by the cool breath of the swollen Tigris waters in the second half of the month, and, on many days, by a fresh north wind.

On the 17th, when a canoe-visit was paid to the inundated island and it was possible to navigate between the poplar-trunks it was noted that the water actually flowed across some parts of the island in an upstream direction ; a strong backwash in the eastern channel enabled me to return a mile upstream in 20 minutes, without paddling a single stroke, but propelled by a strong southerly wind which filled the spread beating-tray.

At the end of the month the island was not yet dry enough to land on, though the high ground appeared again above the surface about the 26th.

These floods are said to bring down snakes which climb into the branches of bushes and trees on inundated islands ; but I myself noted none. Early in the month, the tamarisks came out in white flower ; the low plants (*Polygonum*, dock, etc.), but not the burr, also flowered now. The poplars had fleshy grey-green catkins fully extended, and their thick leaves were already much disfigured by galls. On their trunks micro-lepidoptera abounded, ants were active, and a small red beetle, not noted in March, was seen. The weevil mentioned under March, above, was found in masses under loose poplar-bark, together with companies of caterpillars, large and small, of *Pandesma anysa*, which feed at night : on one strip of bark, no less than twenty larvae in the last instar, of this species were found, not to mention the less mature ones ; and probably every tree contained as many. Most of these would have pupated when the flood came, and would be unable to move higher up the trunk to escape the water, but whether or not the floods would kill the pupae is uncertain. Among such multitudes, the larvae of *Catocala optima*, whose imago was taken here later in the year, were overlooked.

Imagines of *E. pimplaeformis* were on the wing during the first half of the month ; so, still, was *Cerura turbida clarior*'s first brood, though first-brood larvae of *D. intermedia* were full-grown early in the month ; in early April, also, flew the first, brown, generation of *Earias irakana*, and many other moths. Curiously enough, no imagines were now seen of those species, dependent on low herbage, which appeared in profusion in early May (see below), soon after the floods had subsided.

A search on the mainland for the clearwing moth revealed that the poplars on the mainland were affected by a pest not found on the island,

namely, a termite, whose runs are commonly seen on the trunks of *Populus euphratica* by roadsides and in gardens, extending upwards to a height of 12 feet or more; the obvious inference is that submersion is fatal to this insect.

When the island is submerged, the trees form the only refuge for those insects that are not protected by cocoons or by an underground mode of life. At its highest the water is five or six feet deep on the island's highest ground; a mature poplar's branches usually begin at ten feet above the ground. The Euphrates poplar is not pointed in form, but squat and umbrageous. When the island was submerged, many trees seemed, at a distance, to be wearing thick black necklaces, which, as one approached, proved to be clusters of large ants. The commonest animal taking refuge on the tree-trunks was the spider mentioned under March, above, the females carrying their silken balls of eggs behind them. In places where the tips of the rank vegetation in the clearings were just visible on the water's surface, these same spiders were observed hopping about on the water itself. The lady-bird *Chilocorus bipustulatus* L. was seen taking refuge on the tips of tamarisk bushes.

Two cranes (*Grus grus*) were seen in the trees.

In the middle of the month, just at the peak of the flood, the captive pupae formed by the larvae of *Grammodes rogenhoferi* and the two *Clytie* species found on the island the autumn before, started producing imagines. This unfortunate coincidence perhaps accounted for the scarcity of these species in early summer, though by autumn 1937 their larvae were again abundant.

The imagines of *Acronycta aceris johanna* were more fortunate this year, for captive pupae produced no imagines before the last few days of the month, about which time the first imagines from the current year's larvae of *P. anysa* hatched out. The first imago of the second brood of *D. intermedia* emerged in captivity on April 30th.

May :

The river remained at about 108 feet the whole month, so that K. Island was hardly a foot above the water, while N. Island was submerged all the time. The ground was soft, and if one stood for long in one place, one's feet would slowly sink in, and water would collect in the print. Such conditions were very favourable to vegetable growth, and recur regularly at about the same time every year. The heat increased, and, except for occasional rain and thunder, the air grew drier.

The white downy fluff of the poplar catkins started blowing about early in the month, and during May and June covered the ground with a cottony carpet and rested on the tamarisk trees like web or snow. The flood had not hurt the rank undergrowth of dock and *Polygonum*. This vegetation was now alive with spiders and small lepidoptera, the commonest of the latter being *Nomophila noctuella*, and *Eromene islamella*, *Rivula sericealis*, *Nymphula affinialis*, and *Rhodometra sacraria* being also numerous. The western bank of the Tigris (the only bank at this point where these species can breed) was separated by the full width of the river's turbulent main-stream. I incline to believe that the pupae of these species had survived submersion rather than

that they had crossed this barrier in these numbers so soon, for I know that at least two of them are polygonum-feeders ; but certainty is impossible.

Beating tamarisks produced a few coleoptera but no lepidopterous larvae, a great contrast with later in the year. Beating poplar foliage produced small second-brood *anysa* larvae, immature larvae of *N. siva* and *E. irakana*, and many *irakana* imagines, of the second (typical, green) generation; these latter were hard to catch because of their erratic flight when disturbed. Showers of bugs, aphids, beetles and other small insects also fell into the tray from the poplar branches.

Light attracted many lepidoptera, and also swarms of sand-flies, and many lacewing flies, beetles and neuroptera. During the greater part of this month a species of flying grasshopper came to light in swarms all over Baghdad, but none came to light on the island ; one can only conclude that this particular species, like the termite, cannot live under the peculiar conditions of the island. Other kinds of grasshopper do, however, occur on it, as already mentioned ; but they did not come to light. At night the song of crickets and grasshoppers was continuous, and two kinds could be distinguished : a long-drawn-out trilling, and a shriller, interrupted rasping.

Towards the end of the month *Lycaena phloeas* appeared on the island, as well as many fresh *R. sacraria* in perfect condition, presumably just hatched from pupae in the *Polygonum*, on which plant I have found its larvae. *P. rapae* was quite common on the wing also.

Altogether, this was the month of greatest insect-activity, and, unlike the previous May, no submersion checked Nature's processes.

June:

During this month the river steadily fell to about 100 feet above sea-level, and North Island reappeared above water.

Poplar-fluff whitened the island, *Polygonum* was still green, but dock went to seed. In places the young growth of burr was a foot high, but still with no sign of flower. The 'glinus-shelf' was once more exposed, and the thick deposit thereon was pierced by young seedlings, not yet recognisable, and not like *Glinus*. The weather was hot and dry, and the sunlight uninterrupted.

During the first half of the month, insect activity was high, but decreased in the second half. Several moths, of the casual or colonist class, now made their appearance on the island ; the only resident, not previously noted, to be seen in this month for the first time was *Catocala optima* Stgr. (3. vi. 37). *P. anysa* and *E. irakana* were common early in the month ; in the second and subsequent weeks, a beautiful green cicada (*Cicadatra glycyrrhizae* Klti.) appeared, leaving its pupal exuvia on trees and low plants all over the island; the second brood of *Cerura turbida clarior* was noted; and a large, handsome, red-gold bug (*Apodiphus amygdali* Germ.) was noted commonly on poplar trunks. Beating tamarisk began, for the first time in the year, to be productive, young *Clytie* larvae being so obtained. Beating poplar, on the other hand, was, if anything, less productive than before.

July:

By the middle of this month the water had dropped to 98 ft., Karradah Island and North Island were united with each other and the

bank, and it became possible therefore to walk onto them from the East Bund; this had not been possible at the same water-level in December and January, but the bed of the East channel had become two feet shallower during the intervening six months.

A new sandbank having formed in the bed of the main stream just west of the upper end of Karradah Island, the main current of the Tigris, swinging eastwards in a circle round this obstacle, began to make serious inroads on the lower end of North Island and on the 'glinus-shelf' of Karradah Island. All day and all night the splashes of earth-falls from the inner cliff-face of both islands could be heard. Owing to the youth of the vegetation on North Island and the 'glinus-shelf', these places offered less resistance to the erosion than did the lower inner edge of Karradah Island; but even here, cliff-falls occurred and trees were lost. Erosion along the lower, inner edge of the island was a regular, annual phenomenon; erosion, to such a marked degree, of North Island and the upper, inner corner of Karradah Island, was irregular, and had not occurred before 1937. The irregular erosion, occurring just opposite the new sandbank, was much more violent than the erosion occurring a few hundred yards downstream. The result will be seen in the following months.

Dock was dead and stiff on the island; burr not yet mature.

To light, sandflies were numerous; lacewing flies, green cicadas, and beetles also came; moths came in single specimens of a species, except for *Utetheisa pulchella* of which several came to the sheet.

August:

The water fell from 96 to 95 feet during this month.

Serious erosion continued all the month, the widest inroad being made just in the now dry bed of the narrow channel separating Karradah Island from North Island; here, some 20 yards of alluvial soil, unprotected by any vegetable growth, was lost. A sweeping bay, full of eddies, and a few fallen trees, now replaced the lower spit of North Island, the dividing channel, and the 'glinus shelf.' Northwards from this point, a wide sector of North Island disappeared, but the shrub-grown high ground of Karradah Island provided tougher opposition.

The pumps which in winter and spring drew water to irrigate the gardens or fields lying behind the houses on the eastern bund from the eastern channel, were now fed by deep ditches cut through the dry bed of this channel to the main stream of the Tigris; or, in one case, by a pipe running straight across the channel-bed and through the wood to the steep inner cliff of Karradah Island.

The sub-soil water-level fell so low, that the polygonum and dock now formed dense tangles of dead stems of a deep purple colour; the burr, on the other hand, had not yet fruited. The drives and clearings of the island became an almost impassable jungle owing to this undergrowth and the new tall growth of poplar and tamarisk shoots; comfortable walking was only possible under the big poplar trees.

The outer slopes of Karradah Island, which had been covered by the waters of the eastern channel earlier, were now fairly verdant with grass, Indian chickweed (*Glinus lotoides*), and seedlings of poplar and tamarisk. Here, numbers of *Z. karsandra* were seen flying, and *P. rapae*, *L. phloeas*, and *Utetheisa pulchella* were also noted. The gold-red bug

was still common on the trees, and dragonflies, ichneumons and flying beetles were seen. But on the whole, insect life was considerably reduced, with the exception of one or two species that seemed commoner than before, notably *R. sacraria*. The cocoon-fluff of the small parasite of *Acronycta aceris johanna* was a common sight on poplar leaves.

September (1937):

The water fell from 94 to 93 during this month.

Erosion ceased, the Tigris being now at its lowest, slowest and purest, no longer directly washing the inner cliffs of the island. These cliffs were twelve feet high in places. It was still very hot; humidity rose into the thirties, but no rain fell.

Burr (*X. strumarium*) was now fruiting, its best growth being along the outer slopes of the island, between the 12-foot-high tamarisk trees and the 3-foot-high tamarisk shoots; here the burr formed a belt, 15 feet wide at its widest, in which the plants often attained a height of 10 feet.

A second brood of *Acronycta aceris johanna* appeared, and a second, more numerous but smaller, brood of *Lepidogma wiltshirei* Amsel. These species, with other moths, were attracted to light, which seemed now more effective than in August. Lacewing flies, beetles, and large diptera also came to the sheet. Beating tamarisk produced various Noctuid Quadrifid larvae, and beetles and spiders, but beating poplars was unproductive.

Grammodes rogenhoferi, a black moth with a white pattern, proved to be a day-flier, but never left the thick jungle of tamarisk or the belt of burr; in these environments, the intense sunshine variegated with shadows made it extremely hard to follow with the eye, and the vegetation even harder to follow with the net. In the evening it was still active on the wing, together with *Ophiusa algira*, from which it cannot be distinguished until caught.

I also examined the borings of subterranean insects through the silt deposit on the island, which was now cracked and could be picked up in slabs. Vertical passages ran deeper down than was possible to follow them, and in some cases passages were found that had failed to reach the surface; at the top of these, dead cockchafer imagines were found, the same species that came to light commonly in the summer.

October:

The water remained at about 93½ ft. all the month.

The records for this October and November and December were made in 1936, the year before the destructive erosion above recorded.

The surface soil of the whole island was now very dry and cracked. Low plants other than the still luxuriant burr were dead, except low down on the outer (eastern) slopes. In the bed of East channel grass was growing. On the island, many tamarisks had been lopped, some right down to the ground. Westward of, and below, the island, low sandbanks were being cultivated. The channel between Karradah Island and North Island was dry for a length of 150 yards, except for a pool of water in one place, and was even grassier than the bed of East channel. It widened as it led into the main stream, which it did obliquely, being separated from it by a long shelving spit protruding from

the lower inner end of North Island. (This spit was entirely destroyed in summer 1937.) Opposite this spit, on the upper inner corner of Karradah Island, was a gradual slope, steep at the top but more gradual lower down, leading down from the poplar wood to the channel bed which was here quite thirty yards wide. This slope was overgrown with Indian chickweed (*Glinus lotoides*) and is referred to as the ' glinus-shelf'

Examination of a cliff-fall at the lower inner end of Karradah Island (a fall exposing the roots of a poplar tree) shewed that at a depth of nine feet below the surface of the ground long horizontal roots, three or four inches thick, run out from the main stem. A horizontal root was exposed for a length of quite ten feet, and was probably much longer than this in all. Such were the reinforcements to the island's foundations provided by a mature growth of *Populus euphratica.*

Beating tamarisks produced *Macaria aestimaria* larvae and several species of Noctuid-Quadrifid larvae in profusion. Caterpillars of *Laphygma exigua* were found by day under *Glinus* tufts some taking refuge from the heat under a thick slab of cracked mud. At least five species of butterfly were noted, some in abundance, and most of the species of moth mentioned for September were still active.

November:

The water remained at about 95 feet above sea-level till the 28th. About the 22nd light rains fell in Baghdad and heavier rainfall occurred in Northern Iraq. On the 28th the water rose to 102 feet, on the morning of the 29th it stood at 106 feet, and on November 30th it was 112 feet.

Similar rainfall in spring, when the Tigris is already swollen by the melting snows, would be disastrous; but in an almost empty stream-bed, the flood-peak was able to pass swiftly down to the sea without any danger of broken banks.

The first half of the month resembled October climatically, but nights gradually grew colder, the burr plants began to wither, and insects fell off. The pretty tussock-caterpillar of the *Acronycta* decorated the foliage of many a poplar, being especially conspicuous on young, low bushes; and two species of *Clytie* were common at night on low tamarisk shoots. No tamarisk on the island is old or large enough for these larvae to pupate under the bark or in the forks of the branches (as *Clytie sancta* does at Beirut) and they must therefore be obliged to spin up at the roots of the tree. Many of the poplar-feeding larvae, on the other hand, spin cocoons on the trunks of their host-tree, which gives them an advantage over tamarisk-feeders when the floods come. The larvae of the latter are most abundant in autumn, when the river is at its lowest; the poplar-feeders in early summer, when it is at its highest. Nevertheless, a pupa at the root of a tree, if not actually killed by submersion, will have a better chance of producing an imago than a pupa in the ground under *Glinus* or some other low plant, as will be explained under December, below.

December:

By the middle of the month the water had fallen again to 105 feet, and dropped to 97 at the end of the year. At 100 feet North Island was united to Karradah Island by a neck of mud, for the dividing channel was silting up rapidly.

The flood at the beginning of the month no doubt drowned many full-grown larvae on the point of pupation, especially since ovipositing females do not discriminate between high trees and lower growth. Larvae feeding on the former have only to climb upwards to escape the water, but those on the latter must be drowned. This was illustrated by what was seen on a canoe-visit that I made on December 1st, when I paddled down the centre of the island between the trees. On a young poplar-bush some three feet high growing in the main drive, clinging limply to a topmost twig, was a dead full-grown lappet-larva (*Nadiasa siva*); it hung there some 18 inches above the subsiding water-level; but straws on branches indicated that the water had been some two feet higher a day or two before.

No live larvae were seen, though various beetles were found on the tips of tamarisk scrub.

It was noted, on this occasion, that the mud deposit was higher in the tamarisk-scrub than in the clearings and paths and than under the big poplars, where no undergrowth was, for the scrub checked the speed of the water and increased precipitation. In the main drive, I found the water about nine inches deep, with a very soft bottom; bubbles were rising from the mud. I also paddled up a diagonal path or clearing between tamarisk-scrub from the inner side of the island for some way, but was unable to penetrate into the main drive because the water in this clearing was shallower; in fact, in places on either side of the canoe the mud under the tamarisk shoots was already above the water-level; air escaping from under this exposed mud made a loud sizzling sound as it burst the water-film or passed through the shallow puddles in the ridges of the fresh silt.

About the middle of the month, it became too cold for insect activity, the minimum daily temperature being at freezing point for several days. A few hoody crows (*Corvus cornix capellanus*) came to forage on the island, two species of kingfisher were seen, and smaller birds were observed on the shelving upper end of North Island. Flocks of migrating birds passed over Baghdad, flying southwards. Smaller companies of waterfowl occasionally settled in the shelter of the dividing channel.

About two weeks after the re-emergence of the high ground of Karradah Island from the flood-waters, observations of the mud-deposit were made. It was still soft enough to give about an inch when trodden on, was thickly littered with dead poplar leaves, and already cracking. As yet, these cracks were only $\frac{1}{2}''$ wide at the most. They radiated from, or were tangent to, tree-trunks, and a space of at least $\frac{1}{2}''$ was left round every trunk or thick stem, where the mud, solidifying, had drawn away. This was even so where quite young tamarisk shoots, growing from old roots, pierced the silt, but not where grasses or low plants protruded. If not entirely covered with mud, the protruding blade of grass or twig of the low plant, was tightly gripped in the deposit, and no interval or crack was there to permit the upward passage of any insect resting at the roots that might have survived the submersion. The fresh, sloping mud deposit, on the 'glinus-shelf' was cracking, indeed, at its drier higher levels, but the vegetation played no part here in determining the course of these cracks. If a crack touched a glinus stem, it was quite by chance, nor was the stem, even in this case, free from the mud on either side; in the majority of cases the

glinus was completely smothered by the mud. I concluded therefore that these conditions would prevent any *exigua* pupae surviving the winter here, or elsewhere on the island, for this plant only grew at one level on the island's slopes. The 'shelf' would, of course, be under water longer than the higher parts of the island; in fact the water-graph shews that the levels of the island at which this plant grows are submerged for five whole months. This consideration enabled me to distinguish between two classes of low herbage, and of moths feeding thereon: firstly, those, like *R. sacraria* and *N. noctuella* dependent on the *Polygonum*, etc., of the clearings on the higher part of the island; and, secondly, those insects dependent on the *Glinus* and crops of cucumber and beans, etc., at a lower level. The relatively short submersion of the first class, and the relatively light silt-deposit, would perhaps permit a certain proportion to survive the floods; but the longer submersion and consequently heavier silt-deposit affecting such species as *Lampides baeticus* and *Laphygma exigua* would certainly never permit them to be more than summer colonists of the island.

Annotated List of Lepidoptera of Karradah Island

The species taken during the year on the island are here grouped into three classes :—

1. Permanent residents (22).
2. Temporary colonists (8).
3. Casual visitors (17).

The numbers in brackets above represent the number of so-called Macro-Lepidoptera in each class, totalling 47 species. Owing to my comparative ignorance of the biology of many of the Micro-Lepidoptera and Pyralididae, these families are listed at the end all together (20 species); their status on the island is given where possible. I am indebted to Dr. H. G. Amsel for the identification of these latter families. For the identification of the larger moths I must acknowledge the assistance given by Mr. W. H. T. Tams, Monsieur Charles Boursin, and Herren Daniel and Warnecke.

The division into Macro- and Micro-Lepidoptera is not in accord with latest taxonomic thought, and is only followed here for convenience.

I. Permanent Residents

NOTODONTIDAE

1. Dicranura intermedia Teich.

Bi-voltine, both broods being vernal, the first flying in mid-March, the second in early May. Foodplant :—*Populus*. (On the mainland also on willow, *Salix*.) Early stages were described by me in *Mitt. Muench. Ent. Ges.* 1939, Heft 1 with a photograph. An Anatolian-Iranian species, ranging from East Turkey to North-West India, inhabiting oases; it reaches the mouth of the Tigris. It is a close relative of the European species *vinula* L. which reaches West Turkey. For the genitalia of both, see my article : Middle East Lepidoptera–V. (*Proc. R. Ent. Soc. Lond.* (B) 15. Parts 9–10, 1946).

2. **Cerura turbida** Brandt **clarior** Wilts.

Bi-voltine, both broods being vernal, the first flying in March and April, the second in May and June. Foodplant:—*Populus euphratica*. The early stages were described by me with photographs and the paler Baghdad race was named and described in 'Early stages of Oriental-Palaearetic Lepidoptera, V' [*Journ. Bombay Nat. Hist. Soc.*, xliii, (4) p. 624, April 1943]. An Anatolian-Iranian species of limited range, only known from Iraq and South-west Persia; in South-east Turkey, in Syria, in North-west and North-central Persia, closely related but distinct species occur in oases, but not on the same species of poplar.

3. **Pygaera pigra ferruginea** Staudinger.

Multivoltine or bi-voltine; its exact phenology at Baghdad has not been worked out. I took a female by beating poplar on May 5th, and a male on the mainland on 20th April. Foodplant:—*Populus* (and on mainland *Salix*). A well-known Euro-Siberian species. It is not known on the Tigris south of Baghdad, but occurs at 7,000 ft. in South-west Persia much further south. An oasis species.

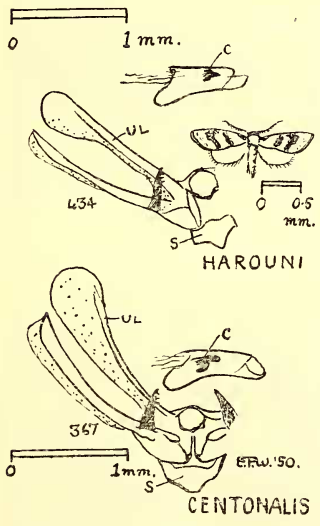
ARCTIIDAE, NOLINAE

4. **Celama harouni** sp. n.

This new species is closer to *centonalis* Hubn. than the following, *turanica* Stgr. It differs from the latter principally in having antennae as in *centonalis*, and not with fascicles of cilia as in *turanica*. From both the straight course of the ante-median fascia on the forewing separate it. Its browner coloration also distinguishes it.

Male antenna, ciliate.

Fore-wing, light brown marked with dark brown as follows: a basal patch, not reaching the hind-margin; near the costa it is composed of raised scales and its distal edge is parallel with the ante-median line and hind-margin; the ante-median line, starting at the sub-costal from a patch of raised scales; its distal edge is almost black, and sharply defined; and thirdly, the post-median fascia, with an equally dark and sharply-defined distal edge, but dentate as in *centonalis*; on the costa, just proximal to this line, is a patch of dark brown raised scales. Except for these markings, the forewing is pale, especially in the median and sub-marginal areas. Sub-marginal shade, obsolete, irregular. Termen, brown. Fringes, concolorous, darker distally.



(For explanation of text-figure see end of article)

Hind-wing, whitish, semi-transparent, with a weakly defined fuscous termen.

The male genitalia (see text-figure) are very like those of *centonalis*, but differ in the membranous part of the upper lobe of the valve; this part is narrower in the centre of the lobe. The

saccus is more pointed; and the aedeagus cornutus is also acuter than in *centonalis*, in Cyprian examples of which the cornutus is bluntly rounded.

Holotype : ♂, (Prep. 434), 1. xi. 43, Basra, S. Iraq (in coll. m.)

Bi-voltine, the broods being vernal and autumnal.

Foodplant :—probably tamarisk, perhaps also poplar. This new species, hitherto undiagnosed, and perhaps existing in many collections under the name *squalida* Stgr., probably also occurs in Syria and elsewhere in the Middle East. Its geographical classification is at present doubtful. I took it on Karradah Island on April 3rd and again on November 16th. An oasis species.

5. **Celama turanica** Stgr.

Quite common to light among poplars in June, but from its captures elsewhere it evidently has more than one brood. I have taken it at Basra on 19. iv and 9. ix. 43. I consider *henrioti* Warnecke and *parvula* Chret. conspecific with *turanica* and therefore class this species as Pan-Eremic. Foodplant :—probably tamarisk, possibly also poplar. An oasis species.

LASIOCAMPIDAE

6. **Nadiasa** (= **Taragama**) **siva** Lef.

Has about two broods annually, not very well defined, for some larvae hibernate, others do so in the pupal stage. Foodplants :—*Populus* and *Tamarix* ; (also, on the mainland, *Zizyphus*, *Prosopis*, apple, pomegranate, etc.) An Indian species, firmly established in Southern Iraq, where it inhabits oases.

LYMANTRIIDAE

(7. **Ocneria signatoria poenitens** Stgr.

I did not take this on the island, and perhaps it cannot survive floods, but on the whole I think it is a permanent resident ; in any case it belongs to the riverain ecofauna. Bi-voltine, flying vernally and autumnally, April and October ; larvae of the second brood pupate in December. I described and illustrated the early stages in *Mitt. Muench. Ent. Ges.* xxix. Heft 1. 1939. An Anatolian-Iranian species, inhabiting Palestine. A close relative inhabits North-west Africa. Foodplant :—tamarisk).

AEGERIIDAE

8. **Eusphecia pimplaeformis** Ob.

Univoltine, vernal, flying in April. Foodplant, *Populus euphratica*, boring inside the trunk. (On the mainland at Baghdad it was also found only on this tree, but in Persia I have also noted it on *Salix*.) For the early stages see my ' The Butterflies and Moths of Iraq ' (Directorate-General of Agriculture, Baghdad, October 1944), and for the morphology see Le Cerf ' Aegeriidae nouvelles ou peu connues d'Asie anterieure ' (*Zeit. des Oest. Ent.-Ver.* 22, 1937.) An Anatolian–Iranian species which does not seem to occur on the Tigris much further South of Baghdad, but occurs in oases at 5,000 ft. in Fars (Sout-west Persia). It has not been taken further west than Bithynia.